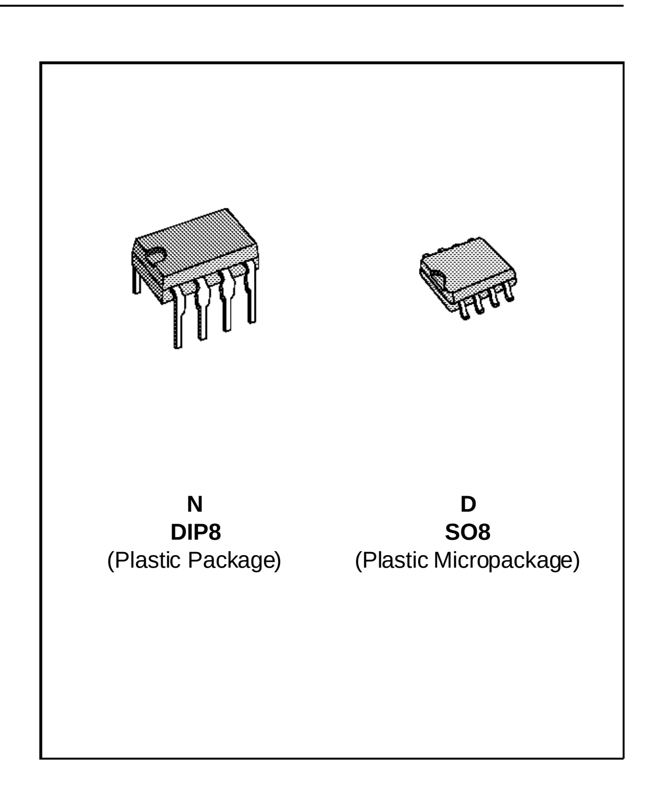


LM193 - LM293
LM393

LOW POWER DUAL VOLTAGE COMPARATORS

- WIDE SINGLE SUPPLY VOLTAGE RANGE OR DUAL SUPPLIES +2V TO +36V OR ±1V TO ±18V
- VERY LOW SUPPLY CURRENT (0.4mA) INDEPENDENT OF SUPPLY VOLTAGE (1 mW/comparator at +5V)
- LOW INPUT BIAS CURRENT : 25nA TYP
- LOW INPUT OFFSET CURRENT : ±5nA TYP
- LOW INPUT OFFSET VOLTAGE : ±1mV TYP
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LOW OUTPUT SATURATION VOLTAGE : 250mV TYP. (I_O = 4mA)
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE SUPPLY VOLTAGE
- TTL, DTL, ECL, MOS, CMOS COMPATIBLE OUTPUTS



DESCRIPTION

These devices consist of two independent low power voltage comparators designed specifically to operate from a single supply over a wide range of voltages. Operation from split power supplies is also possible.

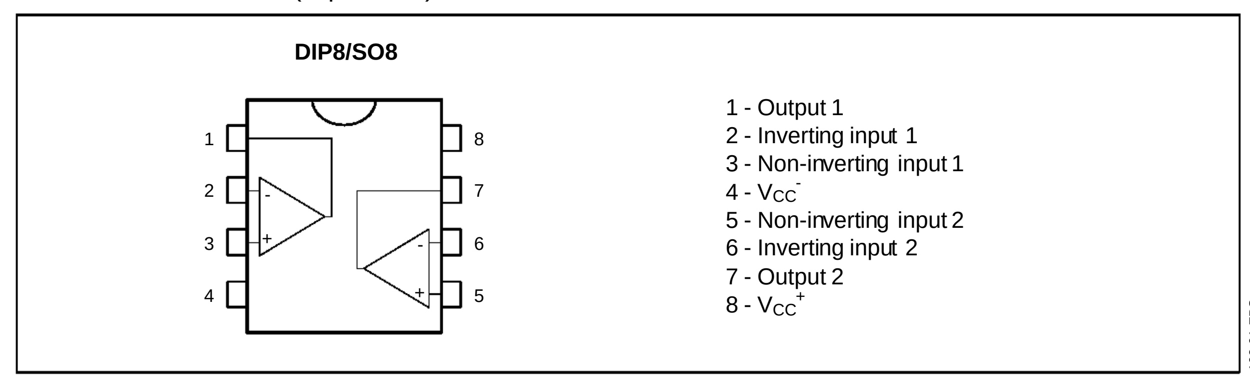
These comparators also have a unique characteristic in that the input common-mode voltage range includes ground even though operated from a single power supply voltage.

ORDER CODES

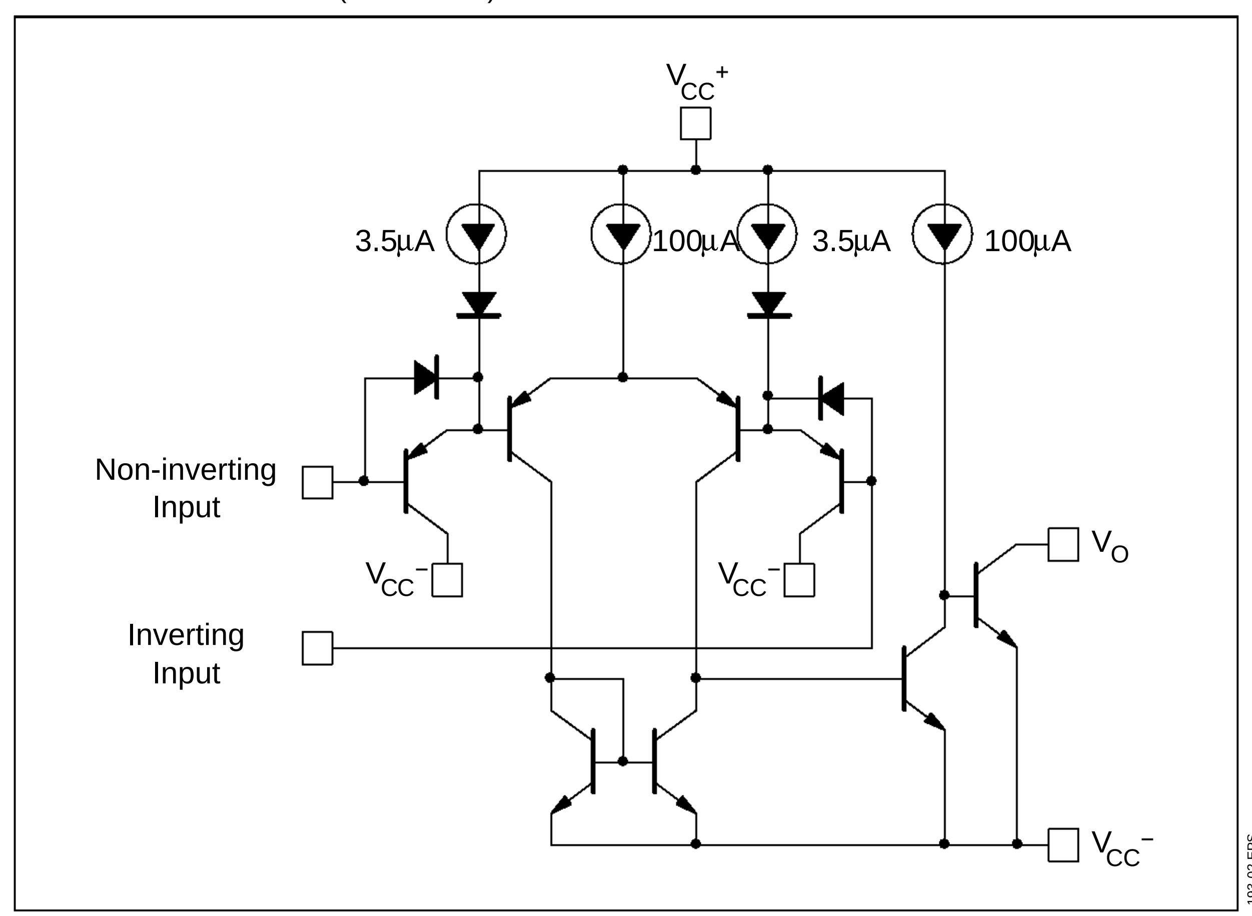
Part Number	Temperature Range	Package N	Package D
LM193	–55, +125°C	•	•
LM293	–40, +105°C	•	•
LM393	0, +70°C	•	•
Example : LM393D			

193-01.TBL

PIN CONNECTIONS (top views)



SCHEMATIC DIAGRAM (1/2 LM193)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	LM193	LM293	LM393	Unit
V_{CC}	Supply Voltage	±18 or 36	±18 or 36	±18 or 36	V
V_{id}	Differential Input Voltage	±36	±36	±36	V
V_i	Input Voltage	–0.3 to +36	–0.3 to +36	–0.3 to +36	V
	Output Short-circuit to Ground – (note 1)	Infinite			
P_{tot}	Power Dissipation	830			mW
T_{oper}	Operating Free-air TemperatureRange	–55 to +125	–40 to +105	0 to +70	°C
T_{stg}	Storage Temperature Range	–65 to +150	–65 to +150	–65 to +150	°C

193-02.TBL

Notes : 1. Short-circuit from the output to V_{CC}^+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of V_{CC}^+.

ELECTRICAL CHARACTERISTICS

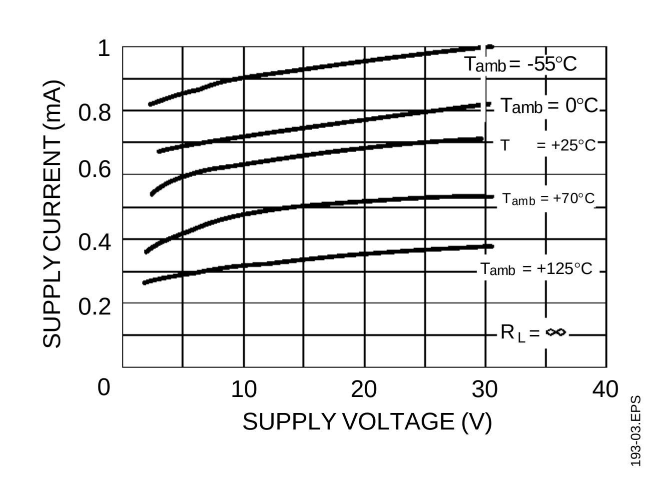
V_{CC}^{+} = +5V, V_{CC}^{-} = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	LM193 - LM293 - LM393			Unit
		Min.	Typ.	Max.	
V_{io}	Input Offset Voltage – (note 2) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 1	 5 9	mV
I_{ib}	Input Bias Current – (note 3) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 25	 250 400	nA
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$		 5	 50 150	nA
A_{vd}	Large Signal Voltage Gain V_{CC} = 15V, R_L = 15kΩ, V_o = 1 to 11V	 50	 200		V/mV
I_{CC}	Supply Current (all comparators) V_{CC} = 5V, no load V_{CC} = 30V, no load		 0.4 1	 1 2.5	mA
V_{icm}	Input Common Mode Voltage Range - (note 4) T_{amb} = +25°C $T_{min.} \leq T_{amb} \leq T_{max.}$	 0 0		 V_{CC}^{+} -1.5 V_{CC}^{+} -2	V
V_{id}	Differential Input Voltage - (note 6)			V_{CC}^{+}	V
I_{sink}	Output Sink Current (V_{id} = -1V, V_O = 1.5V)	 6	 16		mA
V_{OL}	Low Level Output Voltage (V_{id} = -1V, I_{sink} = 4mA) T_{amb} = 25°C $T_{min.} \leq T_{amb} \leq T_{max}$		 250	 400 700	mV
I_{OH}	High Level Output Current (V_{id} = 1V, V_{CC} = V_O = 30V) T_{amb} = 25°C $T_{min.} \leq T_{amb} \leq T_{max}$		 0.1	 1	 nA µA
t_{re}	Response Time (R_L = 5.1kΩ to V_{CC}^{+}) – (note 5)		 1.3		µs
t_{rel}	Large Signal Response Time (V_i = TTL, V_{ref} = +1.4 V, R_L = 5.1kΩ to V_{CC}^{+})		 300		ns

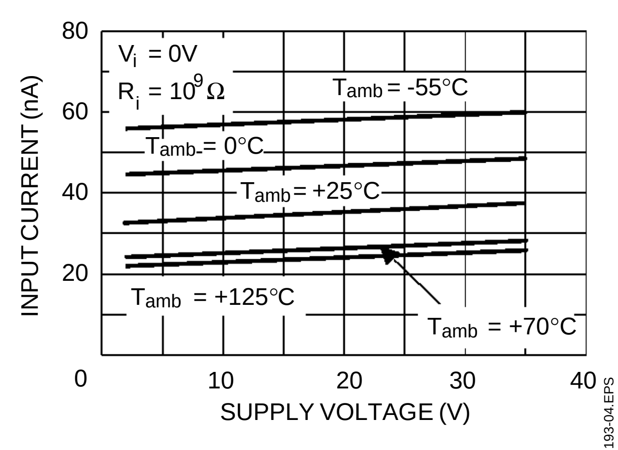
193-03.TBL

Notes :
2. At output switch point, $V_O \approx$ 1.4V, R_S = 0Ω with V_{CC}^{+} from 5V to 30V and over the full input common-mode range (0V to V_{CC}^{+} 1.5V).
3. The direction of the input current is out of the IC due to the PNP input stage. This current is essentially constant, independent of the state of the output, so no loading charge exists on the reference or input lines.
4. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V.
   The upper end of the common-mode voltage range is V_{CC}^{+} –1.5V, but either or both inputs can go to +30V without damage.
5. The response time specified is for a 100mV input step with 5mV overdrive. For larger overdrive signals 300ns can be obtained.
6. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range the comparator will provide a proper output state. The low input voltage state must not be less than –0.3V (or 0.3V below the negative power supply, if used).

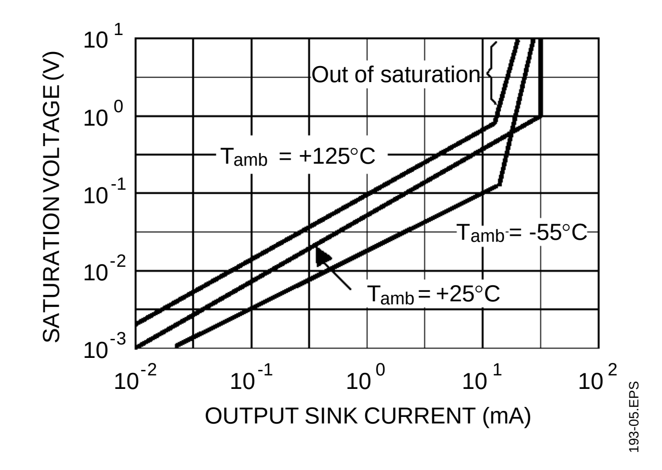
SUPPLY CURRENT versus SUPPLY VOLTAGE



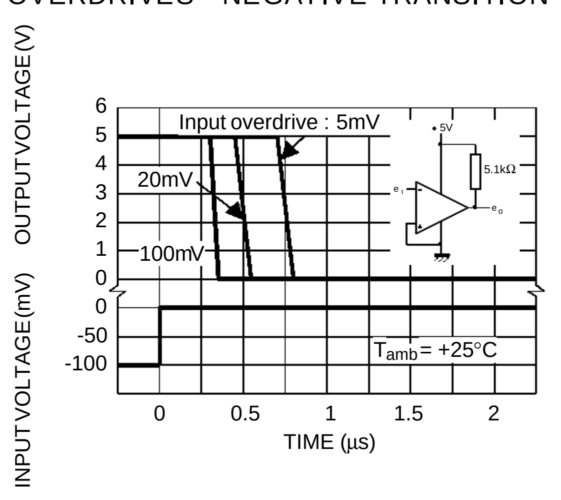
INPUT CURRENT versus SUPPLY VOLTAGE



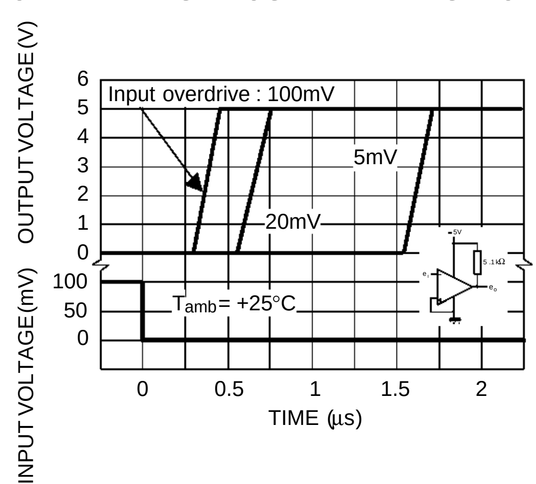
OUTPUT SATURATION VOLTAGE versus OUTPUT CURRENT



RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - NEGATIVE TRANSITION

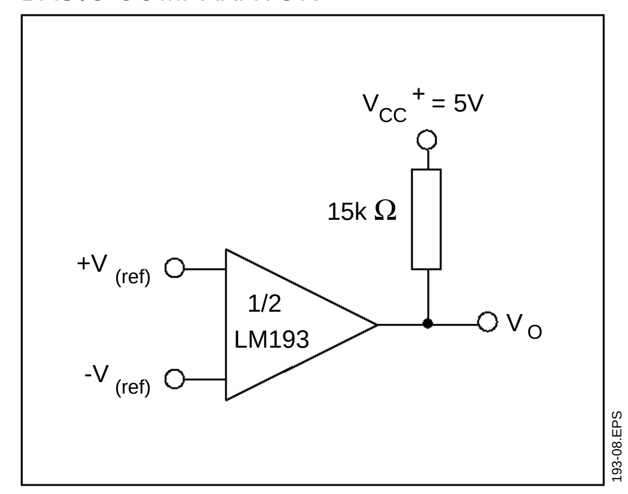


RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES - POSITIVE TRANSITION

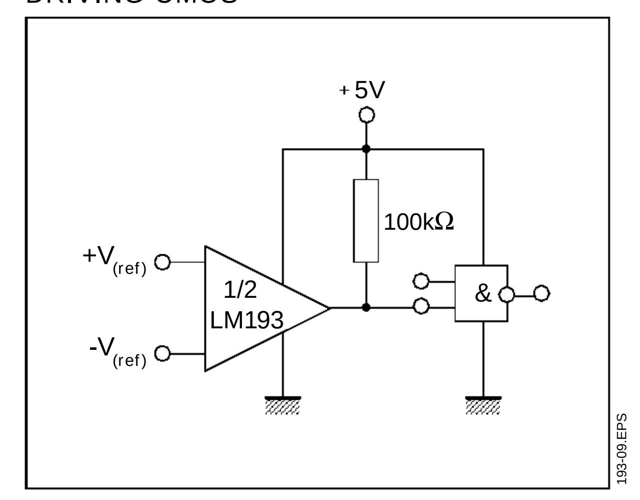


TYPICAL APPLICATIONS

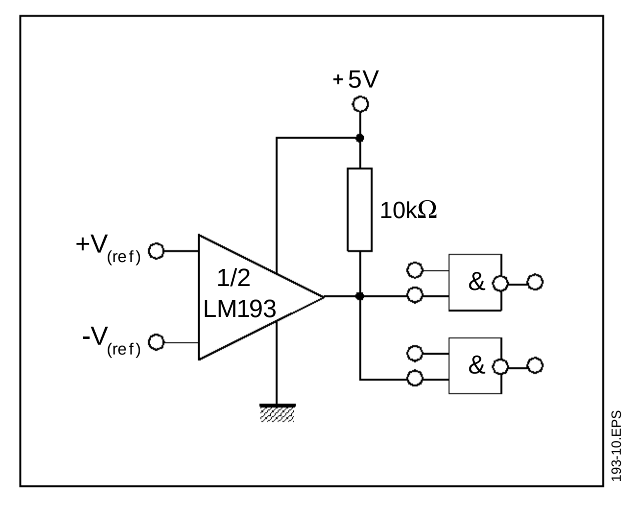
BASIC COMPARATOR



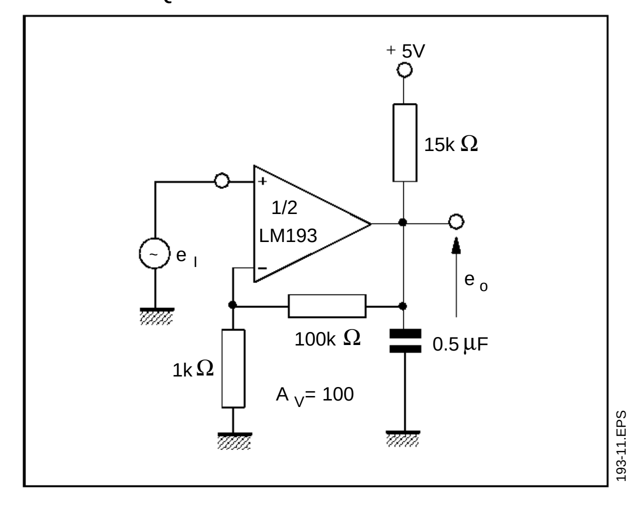
DRIVING CMOS



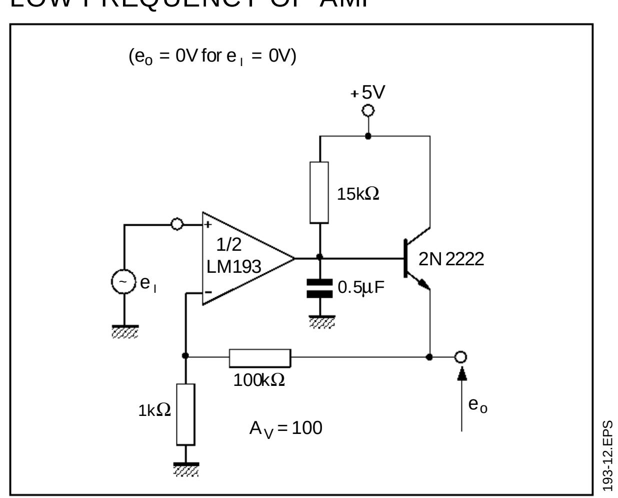
DRIVING TTL



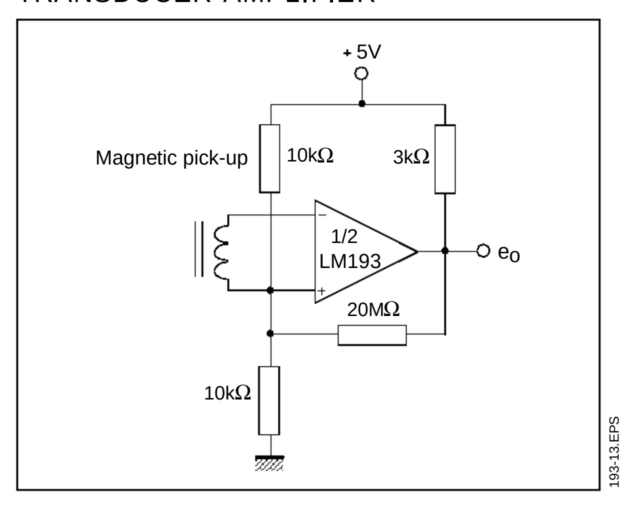
LOW FREQUENCY OP AMP



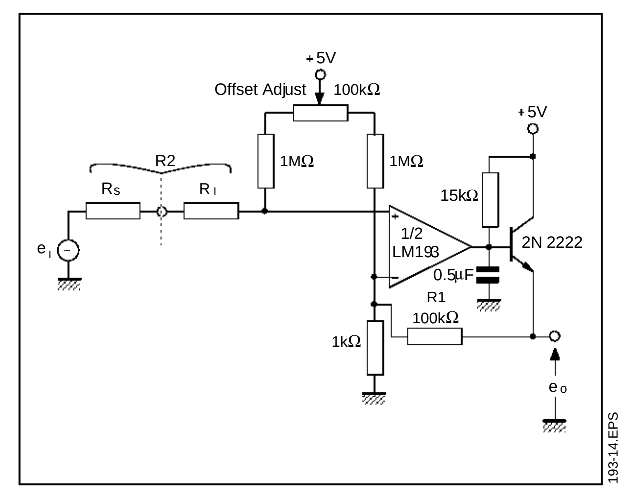
LOW FREQUENCY OP AMP



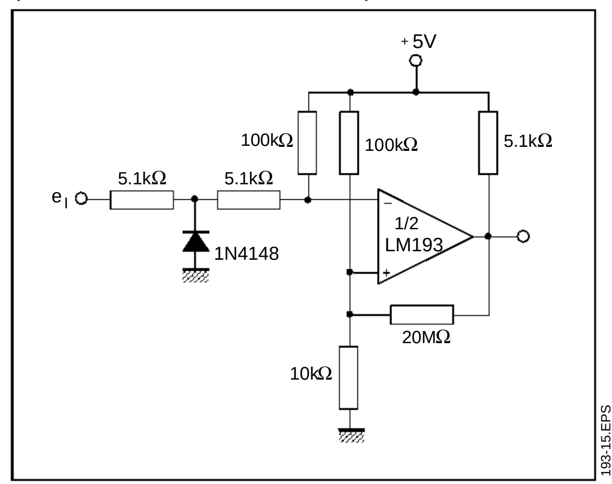
TRANSDUCER AMPLIFIER



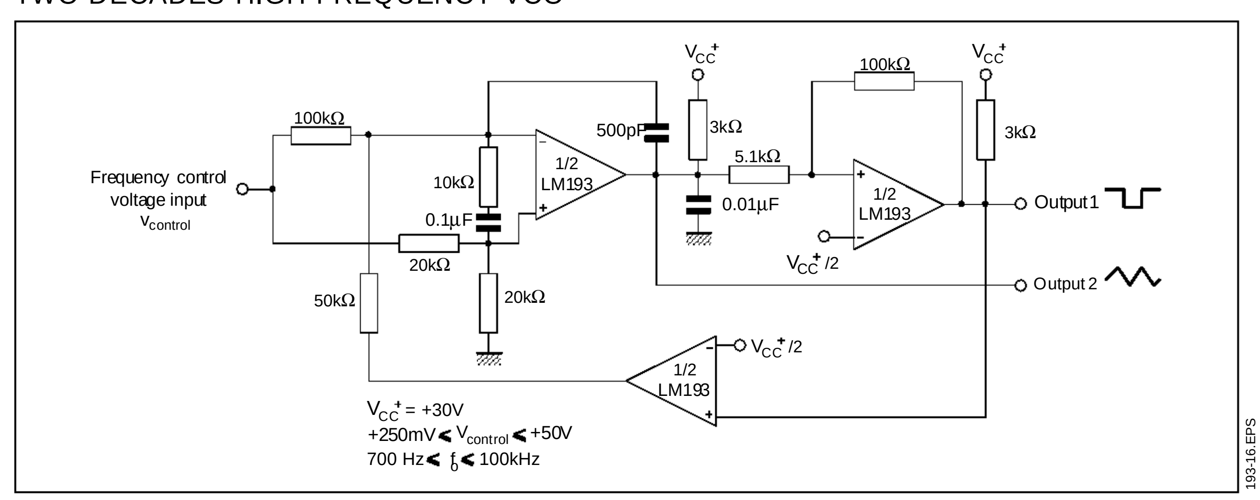
LOW FREQUENCY OP AMP WITH OFFSET ADJUST



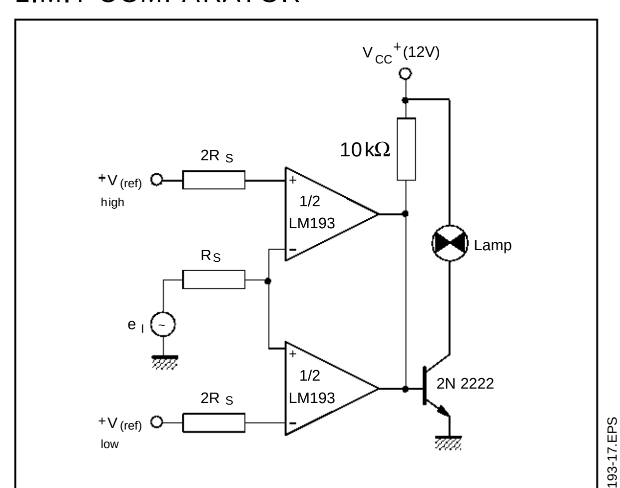
ZERO CROSSING DETECTOR (SINGLE POWER SUPPLY)



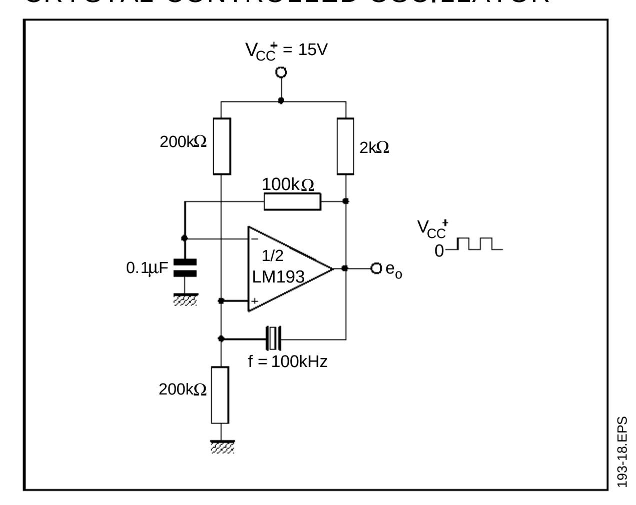
TWO DECADES HIGH FREQUENCY VCO



LIMIT COMPARATOR

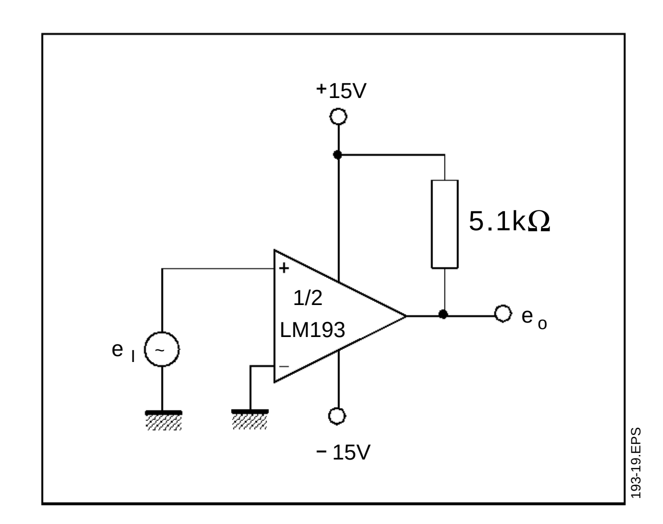


CRYSTAL CONTROLLED OSCILLATOR

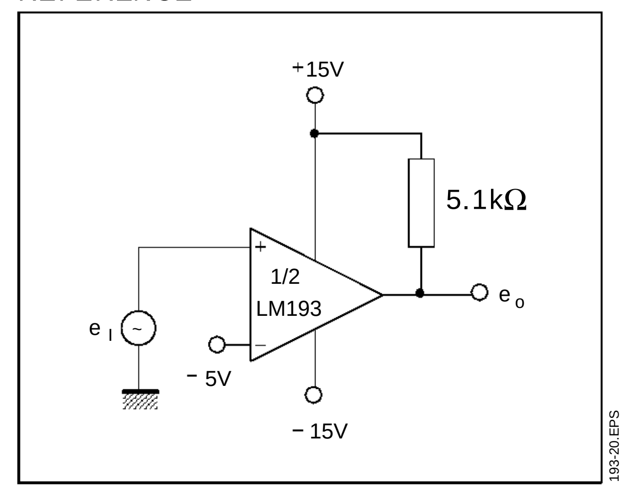


SPLIT-SUPPLY APPLICATIONS

ZERO CROSSING DETECTOR

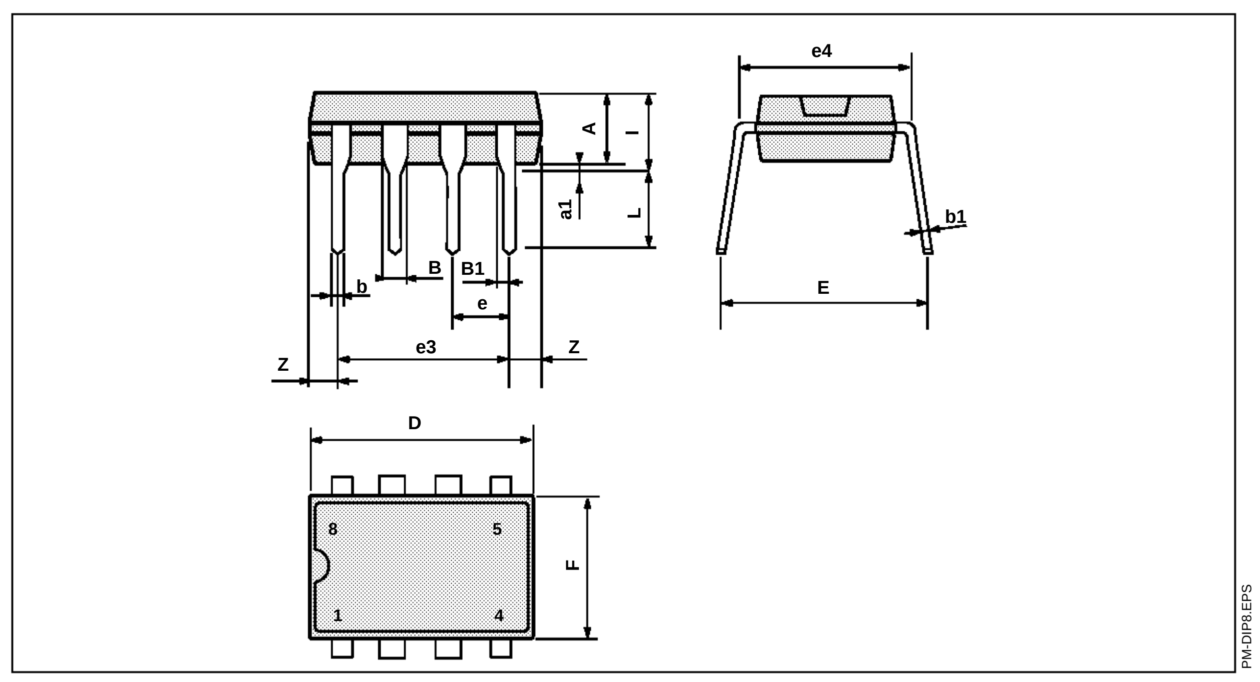


COMPARATOR WITH A NEGATIVE REFERENCE



PACKAGE MECHANICAL DATA

8 PINS -PLASTIC DIP OR CERDIP

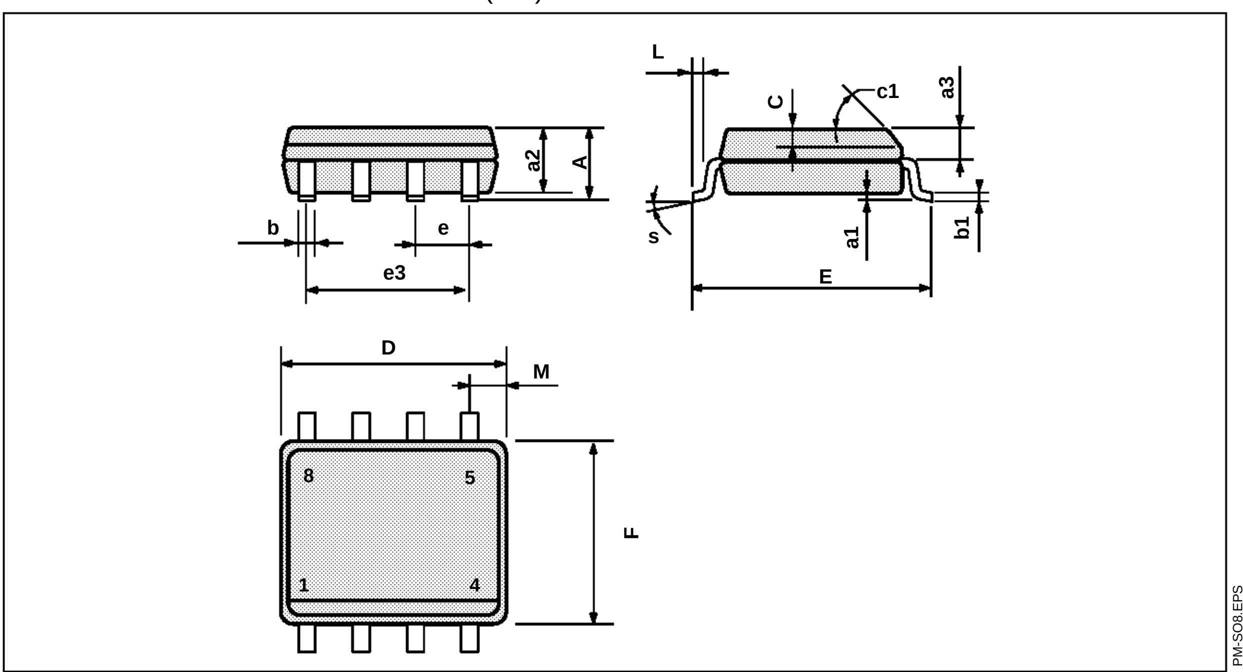


Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

DIP8.TBL

PACKAGE MECHANICAL DATA

8 PINS -PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45^{o} (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8^{o} (max.)					

SO8.TBL

